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**Liu**

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(54) **METHOD AND SYSTEM OF DETERMINING USER TERMINAL POSITION USING A MEASURED SIGNAL PROPAGATION DELAY AND DOPPLER SHIFT OF A COMMUNICATIONS LINK**

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(75) Inventor: **Xiangdong Liu**, Germantown, MD (US)

*Primary Examiner*—Dao Phan

(73) Assignee: **Hughes Electronics Corporation**, El Segundo, CA (US)

(74) *Attorney, Agent, or Firm*—John T. Whelan; Michael W. Sales

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#### **Related U.S. Application Data**

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(51) **Int. Cl.**<sup>7</sup> ..... **H04B 7/185**

(52) **U.S. Cl.** ..... **342/357.05**; 342/357.01; 342/357.04

(58) **Field of Search** ..... 342/357.01, 357.04, 342/357.05; 455/12.1; 701/207

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#### (57) **ABSTRACT**

A system (20) and method (40) for determining a user terminal (23) location on the surface of the earth relies on the signal propagation delay and Doppler shift of radio frequency (RF) transmissions between the user terminal (UT) (23) and a satellite (22). An iterative procedure is employed to improve the accuracy of the location determination. Within the procedure, the position of the UT is estimated based on the propagation delay, Doppler shift, and a spherical approximation of the earth's shape. The radius of the earth at the estimated UT position is adjusted using a predetermined model of the earth's shape, such as an ellipsoid approximation. The adjusted radius value is then used to re-estimate the UT location using the spherical approximation. The iterative procedure continues until the estimated UT location converges to a predetermined accuracy. The position of the user terminal location can be determined based on a earth-central angle  $\alpha$  and an azimuth angle  $\beta$ , which can be directly derived from the signal propagation delay and Doppler shift, respectively, using a set of closed-form equations.

**15 Claims, 3 Drawing Sheets**

